Remarks

Reconsideration and allowance of this application are respectfully requested.

Previously presented claims 42-105 and 107-117 remain pending in the application, with claims 51, 52, 54, 95-99, 108, 109, and 112-116 withdrawn from consideration as being directed to a non-elected invention. Claim 42 is independent.

For at least the reasons presented herein, Applicant respectfully submits that each of the rejections is obviated, and that each of the claims presently under consideration is allowable. And, since each of the withdrawn process claims depends, either directly or indirectly, from generic claim 42, Applicant is entitled to consideration of process claims 51, 52, 54, 95-99, 108, and 109.

35 U.S.C. § 103(a) - Sjoberg, Hardy, and Miyauchi or Kent

Claims 42-48, 53, 55-93, 100-105, and 117 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,106,761 to Sjoberg et al. (hereinafter "Sjoberg") in view of U.S. Patent No. 5,918,641 to Hardy et al. ("Hardy") and either of U.S. Patent No. 3,513,228 to "Hirokazu et al." [*sic*, H. Miyauchi et al. ("Miyauchi")] or U.S. Patent No. 2,528,523 to Kent. In the "Response to Arguments" section, the examiner states that Applicant's argument that Sjoberg discloses a method of producing

pipes with a thickness of 2.5 mm and as standalone pipes is not persuasive (Office Action page 7). The examiner also states that "claim 42 does not positively require more than one layer" (Office Action page 8).

The rejection of claims 42-48, 53, 55-93, 100-105, and 117 based on Sjoberg, Hardy, and Miyauchi or Kent is respectfully traversed. For at least the following reasons, the combined disclosures of Sjoberg, Hardy, and Miyauchi or Kent would not have rendered obvious Applicant's claimed invention.

By way of review, instant claim 42 defines "[a] process for the production of a flexible unbonded offshore pipe having a polymer layer with a thickness of at least about 4 mm." The process comprises

> shaping said polymer layer from a polymer material by extrusion in an extrusion station and cross-linking said extruded polymer material, said polymer material including a polyethylene and a peroxide for providing the cross-linking of the polymer material, said peroxide having an activation temperature substantially above a temperature of the polymer material during the extrusion thereof, said cross-linking of said extruded polymer material being carried out by exposing the extruded polymer material to electromagnetic waves selected from the group consisting of infrared radiation and microwave radiation.

However, there is, *inter alia*, simply no teaching in any of Sjoberg, Hardy, and Miyauchi or Kent that would have led one to select the references and combine them, let alone in a way that would produce the invention defined by Applicant's claim 42.

"Flexible unbonded pipes" are pipes with several layers

In this connection it should be observed that "flexible unbonded pipes" are, by accepted definition, a special type of pipe for offshore use which, as described in the instant specification (page 1, lines 18-19), include at least one inner liner (the innermost polymer layer - page 2, lines 10-11) and at least one reinforcement layer. At specification page 6, line 1, it is specified that:

> [a] flexible offshore pipe is also denoted an unbonded pipe, which means that the pipe comprises two or more layers which are not bonded along their entire length so that the individual layers can slide with respect to each other. This feature gives the offshore pipe a high flexibility.

In other words, in view of the definition of a flexible unbonded offshore pipe, claim 42 includes the feature that the flexible unbonded pipe produced should have at least one polymer layer and at least one reinforcement layer which are not bonded to each other along their length.

"Flexible unbonded pipes" versus the tubes of Sjoberg

To a person having ordinary skill in the art, Applicant respectfully submits that the art of flexible unbonded pipes is quite distinguishable from the art of water tubes as described in Sjoberg. In practice, flexible unbonded pipes for offshore use have an inner diameter of at least about 5 cm. Due to the forces

which will be exerted on and inside the pipes, it is practically impossible to produce such pipes with an inner diameter that is smaller than about 5 cm.

The American Petroleum Institute's *Recommended Practice for Flexible Pipe*, 17B, is a publication based on a Joint Industry Project ("JIP"). As explained in the foreword, the JIP has been supported by a large number of stake holders, which individually of each other, have provided their comments and suggestions to the API 17B publication. The API 17B publication is updated every 4 to 5 years. The attached API 17B '98 and API 17B '02 are the second and third edition, respectively. (An Information Disclosure Statement that discloses the sections of the API's *Recommended Practice for Flexible Pipe* that are referred to herein is being filed concurrently herewith.)

It should be clear that the most recent API 17B publication is accepted as the standard used by the skilled persons within the field of flexible offshore pipes.

Referring to section 4.2.2.2.2 in API 17B '98 and API 17B '02 it can be seen that it is standard practice that the smallest inner diameter of flexible unbonded pipes is about 5 cm.

The polymer layer with at least an inner diameter of 5 cm and at least a thickness of 4 mm is thus very heavy, and the skilled person would not expect the method of Sjoberg to be useful for the production of a polymer layer of such dimensions.

The aforementioned should also be seen in the light that Sjoberg teaches using radiation to heat the polymer to a sufficient level for the crosslinking to be initiated, with the wavelength being selected such that it differs from the wavelengths which are absorbed by the polymer material in question (Sjoberg, column 3, lines 17-20).

Applicant notes that heating with radiation wavelength is a function of the conversion of the wave energy to heat energy, and that the aforementioned only takes place when the waves are absorbed by a material. A material that is transparent to certain waves will not be heated by such waves passing through the material. In other words, seeking to heat a polymer layer having a thickness of 4-18 mm or more to a crosslinking temperature using radiation where the wavelength is selected such that it differs from the wavelengths which are absorbed by the polymer material would not be possible.

On the other hand, Sjoberg teaches that using a radiation with wavelengths which are absorbed by the polymer material would result in an uneven heating and high risk of local overheating (Sjoberg, column 2, line 58, through column 3, line 6).

Accordingly, the skilled person would have *no* expectation of success in seeking to apply the method of Sjoberg in the production of a polymer layer of a flexible unbonded pipe. That is, he would know that absorption of the radiation would be necessary to generate the necessary heat, and he would know that

the absorption would likely provide local overheating which would not be accepted within the art of flexible unbonded pipes.

In this connection, Applicant notes that a flexible unbonded offshore pipe should be able to transport aggressive fluids, and to withstand *high pressures, temperatures and variations thereof* during use. Furthermore, such a pipe should have a long service lifetime, which in offshore guidelines normally is specified to be *20 years or longer*. The consequence of a leak of a polymer layer in such a pipe can be *catastrophic*.

Teaching away

Hardy discloses a flexible pipe of the art in question having an inner liner of polyethylene ("PE") crosslinked by hydrolysis.

At the time of the present invention, the person having ordinary skill in the art of flexible unbonded pipes was very familiar with the Hardy reference because the therein-disclosed method was the only known method to produce crosslinked polyethylene layers in flexible unbonded pipes.

However, as explained in Applicant's previously-filed replies, Hardy has a clear teaching away from using peroxide crosslinking in the crosslinking of polyethylene layers of flexible unbonded pipes:

> It is known from the European Patent Application 83400256 published under the No. 0,087,344 to improve the

> mechanical behavior of polyethylenes, for large diameter tubes, by chemical cross linking using peroxides. The chemical cross linking method requires large quantities of heat. It has never been able to be implemented on an industrial scale for producing tubes made of polyethylene for high performance flexible structures *insofar as the increase in temperatures required for obtaining the cross linking does not enable the tubes to support their own weight.*

Hardy thus clearly teaches the skilled person that crosslinking of PE using peroxides is *not* applicable within the flexible offshore pipe technology for at least two reasons:

1) It has never been able to be implemented on an industrial scale for producing tubes made of polyethylene for high-performance flexible structures, and

2) The increase in temperatures required for obtaining the crosslinking does not enable the tubes to support their own weight.

The examiner states that it would have been obvious to combine the method of Sjoberg with the pipe of Hardy. Furthermore, the examiner implies that since Sjoberg is employed as the primary reference and Hardy is employed as the secondary reference, the teaching against using peroxide crosslinking in Hardy is irrelevant.

Applicant respectfully submits that the examiner does not put himself in the place of the skilled person and make the analysis based on *all factual information* as is required according

to the pertinent provisions of the *MPEP*. That is, as required by *MPEP* § 2142:

> To reach a proper determination under 35 U.S.C. § 103, the examiner must step backward in time and into the shoes worn by the hypothetical "person of ordinary kill in the art" when the invention was unknown and just before it was made. In view of *all factual information*, the examiner must then make a determination whether the claimed invention "*as a whole*" would have been obvious at the time to that person. (Emphasis added)

One of ordinary skill in the art would know that a flexible unbonded offshore pipe is a specific type of pipe (as explained in the specification and shown in Hardy) that includes a polymer layer for sealing (often called an inner liner) and that can include two or more helically wound wires surrounding the polymer layer. Such flexible unbonded offshore pipe should be able to transport aggressive fluids, to withstand *high pressures, temperatures and variations thereof during use*. Therefore, of course, inducing weakness by a poor or an uneven crosslinking would not be acceptable for this specific service.

Based on the clear teaching against using peroxide-plus-heat for crosslinking the polymer layer of the flexible unbonded offshore pipe, the skilled person would not even consider using the method of Sjoberg.

In other words:

- Combining the method of Sjoberg with the pipe of Hardy *would not result in a predictable result* - i.e., the skilled person would predict the pipe to *collapse*.

- It would not have been obvious to try the aforementioned approach as asserted by the examiner because the skilled person would not expect the method to work.

- Hardy includes a clear warning not to use the peroxide-plus-heat method in the production of flexible unbonded offshore pipes.

Applicant also notes that the barrier against even trying to combine the teaching of Sjoberg with the teaching of Hardy with no expectation of success at the time of the invention was very high for several additional reasons:

a) It would not be possible to perform pre-calculation on the method, and to test the method, a real full-scale test would have to be set up, which added to the barrier for the skilled person - this was not merely a question of trial and error - because the cost in the case of failure would be unacceptably high.

b) The skilled person was faced with a prejudice against using a peroxide-plus-heat process for providing a crosslinked polyethylene layer of a flexible unbonded offshore pipe as explained further below.

Prejudice

For a large number of years and until the instant invention was conceived, the hydrolysis method of producing crosslinked inner liners as disclosed by Hardy was the only available method, even though it was expensive, time consuming, water consuming, and space demanding.

In this connection, Applicant refers to API 17B '98, section 6.2.2 and API 17B '02, section 6.2.2, wherein it is stated:

> XLPE is a special grade of PE which is achieved by a crosslinking process so as to improve the base material characteristics. The crosslinking is generally gained by circulating hot water after the extrusion process.

In other words, at the time of this invention and for years before, it was standard practice within the field of flexible unbonded pipes to provide crosslinked polyethylene ("XLPE") by a hydrolysis process as described by Hardy. Accordingly, the skilled person would not even consider carrying out experiments to determine whether the process using peroxide and heat could be applied.

Therefore, it is clear that there was a prejudice against using a peroxide-plus-heat process for providing a crosslinked polyethylene layer of a flexible unbonded offshore pipe.

In light of this, the present invention provides a large contribution to the art of producing a crosslinked polyethylene layer of a flexible unbonded offshore pipe.

Miyauchi

Miyauchi describes a method of crosslinking a rubber or plastic forming an insulation layer on an electrical wire. The plastic insulation to be crosslinked may be polyethylene. The rubber or plastic is heated using infrared rays to a temperature between 200 and 300°C under a high nitrogen gas pressure (column 1, line 54, through column 2, line 6) to avoid foaming of the polymer.

The person having ordinary skill in the art would not be motivated to combine the teaching of Miyauchi with that of Hardy, and he would not have any expectation of success with the combination for several of the above-explained reasons, including the teaching away and the prejudice as explained above. For example, the skilled person would receive from Hardy the teaching that the polyethylene should not exceed a temperature of 120°C so as to preserve the mechanical properties (Hardy, column 6, lines 54-59). Miyauchi, however, teaches that the temperature should be at least 200°C. The teachings of Hardy and Miyauchi, therefore, are incompatible.

Furthermore, the skilled person would note the risk of foaming of the polymer as taught by Miyauchi. Such foaming of a polymer layer of a flexible unbonded pipe would be unacceptable, and due to the size of a flexible unbonded pipe, it would be expensive and/or difficult to control a sufficiently high nitrogen gas pressure.

Therefore, Applicant respectfully submits that the person having ordinary skill in the art would not even consider combining teachings of Hardy and Miyauchi.

Kent

Kent describes a method of crosslinking polyethylene or plastic to form an insulation on a wire by incorporating in the material a tertiary peroxide, and after shaping of the polyethylene, heating the polyethylene in an oven at 180 - 250°C (column 3, lines 15-25, and column 4, lines 23-27).

The person having ordinary skill in the art would not be motivated to combine the teaching of Kent with that of Hardy, and he would not have any expectation of success with the combination for several of the above-explained reasons, including the teaching away and the prejudice as explained above. For example, the skilled person would receive from Hardy the teaching that the polyethylene should not exceed a temperature of 120°C so as to preserve the mechanical properties (Hardy, column 6, lines 54-59). However, Kent teaches that the temperature should be at least 180°C. The teachings of Hardy and Kent, therefore, are incompatible.

Furthermore, even if the person having ordinary skill in the art did try to combine the teachings of Kent and Hardy, he would not arrive at the presently claimed method. Therefore,

Applicant respectfully submits that the person having ordinary skill in the art would not even consider combining teachings of Hardy and Kent.

Conclusion

The instant invention as defined in claim 42 would not have been obvious over the examiner's asserted combination of Sjoberg, Hardy, and Miyauchi or Kent for at least the following reasons:

1. The skilled person *would not have any expectation of success* in seeking to apply the method of Sjoberg in the production of a polymer layer of a flexible unbonded pipe, because he would know that absorption of the radiation would be necessary to generate the necessary heat and he would know that this would likely provide local overheating which would not be accepted within the art of flexible unbonded pipes.

2. Combining the method of Sjoberg with the pipe of Hardy *would not result in a predictable result* - i.e., the skilled person would predict the pipe to *collapse*.

3. It *would not have been obvious to try* because the skilled person would not expect the method of Sjoberg to work in the field of flexible unbonded pipes.

4. Hardy includes a clear *teaching away* from using the peroxide-plus-heat method in the production of flexible unbonded offshore pipes.

5. The *barrier for the skilled person against trying* to use the method of Sjoberg in the field of flexible unbonded pipes was too high, because it would not be possible to perform pre-calculation on the method, and to test the method a real full-scale test would have to be set up - this was not merely a question of trial and error - because the cost in the case of failure would be unacceptably high.

6. The person having ordinary skill in the art was *faced with a prejudice* against using a peroxide-plus-heat process for providing a crosslinked polyethylene layer of a flexible unbonded offshore pipe.

7. The teaching of Hardy is incompatible with the teachings of both Miyauchi and Kent.

Therefore, the combined disclosures of Sjoberg, Hardy, and Miyauchi or Kent would not have rendered obvious the invention defined by claim 42. Claims 43-48, 53, 55-93, 100-105, and 117 are allowable because they depend, either directly or indirectly, from claim 42, and for the subject matter recited therein.

35 U.S.C. § 103(a)

Claims 49, 50, 94, 107, 110, and 111 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Sjoberg in view of Hardy and either of Miyauchi or Kent, and further in view of WO 99/67560 of Procida et al. ("Procida '560"). Claims 78-81 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Sjoberg in view of Hardy and either of Miyauchi or Kent, and further in view of WO 01/00381 of Heino.

The rejections of claims 49, 50, 94, 107, 110, and 111 and of claims 78-81 are similarly traversed. All of the aforementioned rejected claims depend, either directly or indirectly, from claim 42. Claim 42 is allowable for at least the reasons explained above. Regardless of what Procida '560 and Heino may disclose, their teachings fail to rectify any of the above-described deficiencies of the examiner's asserted Sjoberg, Hardy, and Miyauchi or Kent combination. Accordingly, claims 49, 50, 78-81, 94, 107, 110, and 111 are allowable because they depend from claim 42, and for the subject matter recited therein.

Applicant also notes, as further evidence of the allowability of this application in its present form, that in the already-granted European patent for this invention, the scope of the claims corresponds to the scope of this U.S. application's instant claims.

In view of the foregoing, this application is now in condition for allowance. If the examiner believes that an

interview might expedite prosecution, the examiner is invited to contact the undersigned.

Respectfully submitted,

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